

Cellular Telephone Use and Cancer: Questions and Answers

Key Points

- Cellular telephones emit radiofrequency (RF) energy (see Question 2).
- Exposure to high levels of RF energy can heat body tissue, but RF energy exposures from cellular telephones are too low to cause significant tissue heating (see Question 2).
- Concerns have been raised that RF energy from cellular telephones may pose a cancer risk to users (see Questions 1 and 2).
- Researchers are studying tumors of the brain and central nervous system (CNS) because cellular telephones are held next to the head when used (see Question 4).
- Studies have not shown any consistent link between cellular telephone use and cancer, but scientists feel that additional research is needed before firm conclusions can be drawn (see Question 6).

1. Why is there concern that cellular telephones may cause cancer?

There are three main reasons why people are concerned that cellular telephones (also known as “wireless” or “mobile” telephones) may cause certain types of cancer.

- Cellular telephones emit radiofrequency (RF) energy, a form of radiation, which is under investigation for its effects on the human body (1).
- Cellular telephone technology is relatively new and is still changing, so there are no long-term studies of the effects of RF energy from cellular telephones on the human body (1).
- The number of cellular telephone users is increasing rapidly. According to the Cellular Telecommunications and Internet Association (CTIA), there are now more than 180 million subscribers to cellular telephone service in the United States. This has increased from 110 million users just 3 years ago. Experts estimate that by 2010, there will be 2.2 billion subscribers worldwide.



For these reasons, it is important to learn whether RF energy affects human health, and to provide reassurance if it does not.

2. What is RF energy and how can it affect the body?

RF energy, also called radiowaves, is a form of electromagnetic radiation. Electromagnetic radiation can be ionizing (high-frequency) or non-ionizing (low-frequency) (2). RF energy belongs to the non-ionizing type of electromagnetic radiation. It is known that ionizing radiation, such as that produced by x-ray machines, can present a health risk at high levels of exposure. However, it is not yet known whether non-ionizing radiation poses a cancer risk (2).

The most important use of RF energy is for telecommunications (2). In the United States, cellular telephones operate in a frequency ranging from about 1,800 to 2,200 megahertz (MHz) (1). In that range, the radiation produced is in the form of non-ionizing RF energy. AM/FM radios, VHF/UHF televisions, and cordless telephones (telephones that have a base unit connected to the telephone wiring in a house) operate at somewhat lower radio frequencies than cellular telephones; microwave ovens, radar, and satellite stations operate at somewhat higher radio frequencies (2).

RF energy produces heat, which can increase body temperature and damage those parts exposed to it (1, 2). It is generally agreed that the amount of RF energy encountered by the general public is too low to produce significant tissue heating or an increase in body temperature. However, it is also agreed that further research is needed to determine what effects, if any, low-level non-ionizing RF energy has on the body and whether it is dangerous to people (2).

3. How much RF energy are cellular telephone users exposed to?

A cellular telephone user's level of exposure to RF energy depends on several factors. These include the number and duration of calls, the amount of cellular telephone traffic at a given time, the distance from the nearest cellular base station (a low-powered radio transmitter that communicates with a user's cellular telephone), the quality of the transmission, how far the antenna is extended, and the size of the handset.

A cellular telephone's main source of RF energy is its antenna. The antenna of hand-held cellular telephones is in the handset, which is typically held against the side of the head while the telephone is in use. The closer the antenna is to the head, the greater a person's expected exposure to RF energy. The amount of RF energy absorbed decreases rapidly with increasing distance between the antenna and the user.

Hands-free kits are a relatively recent feature that can be used with cellular telephones for convenience and comfort. These systems reduce the amount of RF energy exposure to the head because the phone, which is the source of RF energy, is not placed against the head (2). However, most studies conducted on cellular telephone use and cancer risk

have focused on hand-held models not equipped with hands-free systems, since they deliver the most RF energy to the user.

The intensity of RF energy emitted by cellular telephones depends on the level of the signal sent to or from the nearest base station (1). A geographic area serviced by a base unit is often referred to as a “cell,” which is why these devices are called “cellular” telephones.

When a call is placed from a cellular telephone, a signal is sent from the antenna of the phone to the nearest base station antenna. The base station routes the call through a switching center, where the call can be transferred to another cellular telephone, another base station, or to the local land-line telephone system. The farther a cellular telephone is from the base station antenna, the higher the power level needed to maintain the connection. This distance, in part, determines the amount of RF energy exposure to the user.

4. What parts of the body may be affected during cellular telephone use?

Because hand-held cellular telephones are used close to the head, there is concern that the RF energy produced by these devices may affect the brain and nervous system tissue in the head. Researchers have focused on whether RF energy can cause malignant (cancerous) brain tumors such as gliomas (cancers of the brain that begin in the glial cells, which are cells that surround and support nerve cells), as well as benign (non-cancerous) tumors, such as acoustic neuromas (tumors that arise in the cells of the nerve that supplies the ear) and meningiomas (tumors that occur in the meninges, which are the membranes that cover and protect the brain and spinal cord) (1).

5. What studies have been done? What do they show?

Many studies have already been done, and research is ongoing. A study funded by Wireless Technology Research LLC and the National Cancer Institute (NCI) was conducted in five academic medical centers in the United States. The study analyzed the possible link between brain cancer and cellular telephone use between 1994 and 1998. The study compared a group of 469 men and women with brain cancer to a group of 422 men and women who did not have brain cancer. Results of the study, published in 2000, found that the use of hand-held cellular telephones was unrelated to the risk of brain cancer, but additional studies covering longer periods of cellular telephone use were recommended (3).

The results of another large NCI-funded study of cellular telephones and brain tumors were published in 2001. It focused on 782 patients with one of three types of brain tumors (glioma, meningioma, or acoustic neuroma) at three medical centers between 1994 and 1998. The control group consisted of 799 patients at the same hospitals who did not have brain tumors. The researchers did not find an increased risk of brain cancer among cellular telephone users. The results showed no evidence of increasing risk with increasing years of use, or average minutes of use per day. The study also found that

brain tumors did not occur more often than expected on the side of the head on which participants reported using their phone (4).

More recently, a series of multinational case-control studies (studies that compare two groups of people: those with the disease or condition under study (cases), and a very similar group of people who do not have the disease or condition (controls)), collectively called INTERPHONE, have been developed and are being coordinated by the International Agency for Research on Cancer (IARC). The primary objective of these studies is to assess whether RF energy exposure from cellular telephones is associated with an increased risk of cancer. The participating scientists are also exploring other possible causes of brain tumors besides RF energy, including external (environmental) and internal (endogenous) risk factors. Genetic (inherited) factors will be studied in collaboration with the NCI consortium of brain cancer studies. Participating countries include Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden, and the United Kingdom (5).

The results of the INTERPHONE study are now being published. The first two articles, both published in November 2004, examine the use of cellular telephones and the risk of the benign tumor acoustic neuroma. A Danish study compared 106 individuals having acoustic neuroma with a control group of 212 people without this condition. The study showed no increased risk of acoustic neuroma in long-term (10 years or more) cellular telephone users when compared to short-term users. Additionally, there was no increase in the incidence of tumors on the side of the head where the phone was usually held (6). A Swedish study, however, compared 148 individuals with acoustic neuroma to 604 healthy individuals. This study suggests there is an increased risk of acoustic neuroma in long-term cellular telephone users, but not in short-term users (7).

Other studies from INTERPHONE investigated whether there is a relationship between cellular telephone use and the risk of the brain tumors meningioma and glioma. A Danish study, published in 2005, compared 175 people with meningioma and 252 people with glioma to a control group of 822 disease-free individuals. This study demonstrated no link between meningioma or glioma and cellular telephone use (8). A Swedish study, published in 2005, compared 273 individuals with meningioma and 371 people with gliomas to 674 people who did not have these conditions. This study also showed that people who use cellular telephones are not at an increased risk of meningioma or glioma (9).

Overall, research has not consistently demonstrated a link between cellular telephone use and cancer or any other adverse health effect.

6. Why aren't the results of the studies consistent?

Scientists have had to assess how much RF energy people have been exposed to by interviewing individuals involved in a particular study about their cellular telephone habits (including frequency of use and duration of calls). Because of this, the accuracy of the data collected is subject to the memory of the people interviewed. Recently,

however, RF-energy-measurement meters have been developed that will accurately measure RF energy exposure (1).

Additionally, cellular telephones have only been widely available for a relatively short period of time (since the 1990s), and cellular technology continues to change (1). For example, older studies evaluated RF exposure from analog telephones; today, most cellular telephones use digital technology. (Analog and digital telephones operate at different frequencies and power levels.) Another new technology is Bluetooth, a wireless technology that allows devices, such as cellular telephones and headsets, to communicate with each other using short-range radio frequency.

Furthermore, brain tumors develop over many years. Scientists have been unable to follow cellular telephone users consistently for the amount of time it might take for a brain tumor to develop (1).

Although research has not consistently demonstrated a link between cellular telephone use and cancer, scientists still caution that more research needs to be done before conclusions can be drawn about the risk of cancer from cellular telephones (1).

7. Do children have a higher risk of developing cancer due to cellular telephone use than adults?

There is no evidence that cellular telephone use poses more of a threat to children than to adults (2). However, no study populations to date have included children, who are increasingly heavy users of cellular telephones and are likely to accumulate many years of exposure during their lives (1).

In addition, children are at greatest risk from agents known to cause brain and nervous system cancers because their nervous systems are still developing. If RF energy from cellular telephones is proven to cause cancer, researchers would expect children to be more susceptible than adults. Again, however, there is no evidence of this to date (1).

8. What can cellular telephone users do to reduce their exposure to RF?

The Food and Drug Administration (FDA) has suggested some steps that cellular telephone users can take if they are concerned about potential health risks from cellular telephones:

- Reserve the use of cellular telephones for shorter conversations, or for when a conventional phone is not available.
- Switch to a type of cellular telephone with a hands-free device that will place more distance between the antenna and the phone user.

Additionally, the Federal Communications Commission (FCC), which regulates interstate and international communications by radio, television, wire, satellite, and cable, provides consumers with information on human exposure to RF energy from cellular telephones

and other devices at <http://www.fcc.gov/oet/rfsafety> on the Internet. This Web page allows consumers to find information about the specific absorption rate (SAR) of cellular telephones produced and marketed within the last 1 to 2 years. The SAR corresponds to the relative amount of RF energy absorbed into the head of a cellular telephone user. Consumers can access this information using the phone's FCC ID number, which is usually located on the case of the phone.

9. Can cellular telephones interfere with medical equipment?

Yes. Cellular telephones can interfere with pacemakers (electrical devices, implanted in the chest, that stimulate or steady the heartbeat), implanted defibrillators (electrical devices that restore a normal heartbeat by applying an electrical shock to the heart), and hearing aids. However, standards have been established that will allow manufacturers to ensure that cardiac pacemakers and defibrillators are safe from cellular telephone RF (2).

Selected References

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Related Resources

Publications (available at <http://www.cancer.gov/publications>)

- National Cancer Institute Fact Sheet 3.46, *Magnetic Field Exposure and Cancer: Questions and Answers*

National Cancer Institute (NCI) Resources

Cancer Information Service (toll-free)

Telephone: 1-800-4-CANCER (1-800-422-6237)

TTY: 1-800-332-8615

Online

NCI's Web site: <http://www.cancer.gov>

LiveHelp, NCI's live online assistance:

<https://cissecure.nci.nih.gov/livehelp/welcome.asp>

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